

Virtualization of Computer Laboratories in Educational Institutions: Centralized Management, Legacy Equipment, and Lower Operating Cost

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2023

Abstract- Maintaining computer laboratories in technical schools, colleges, and distance-education centers consumes staff time, power, and spare parts, especially when each machine is configured by hand. This article discusses virtualization of workstations and of class environments as a laboratory-management model, using evidence published through 2023. It argues that centralized management with distributed execution on hardware already in place reduces configuration failure, allows remote correction of learning platforms, and extends the life of the installed base. The text links Brazilian hybrid-architecture findings to COBIT/ITIL practice and to the regulatory requirement of a computer lab at distance-education centers.

Keywords: *virtualization; computer laboratory; educational IT management; distance education; COBIT.*

I. INTRODUCTION

Institutions that run technical computing programs, adult education, and undergraduate distance-education centers depend on a physical laboratory for opening sessions, examinations, tutoring, and practice. Manual configuration of dozens of stations is costly and fragile: a corrupted image or an outdated driver takes the room out of use on the day of the activity (Lira, Oliveira & Costa, 2023). Commercial laboratory-management suites exist, but license and proprietary-hardware costs are out of reach for many smaller maintaining entities.

The problem is operational as well as pedagogical: power, corrective maintenance, technician travel, and downtime. Documented Brazilian cases show that virtualizing the class environment — desktop, course image and, where possible, remote access — changes that cost structure (Mattedi, 2023; Lira, Oliveira & Costa, 2023). This article organizes that evidence and

draws management implications for whoever runs laboratories across a network of centers.

II. THE LABORATORY AS AN OPERATING ASSET, NOT ONLY A TEACHING ROOM

Decree No. 9,057/2017 defines the distance-education center as a decentralized academic and operating unit and requires physical, technological, and staffing infrastructure consistent with the pedagogical project (Brazil, 2017a). MEC Normative Ordinance No. 11/2017 lists a computer laboratory among the center's minimum items, together with tutoring space, holdings, and ICT resources (Brazil, 2017b). The laboratory is therefore a condition of lawful provision, not an accessory.

In practice the center's IT manager is accountable for three layers at once: (i) room availability on the academic calendar; (ii) identity and permission for whoever reaches the learning platform; (iii) fast recovery when a machine or the network fails. Without a standard image and without remote access, every failure becomes an on-site visit.

III. MODELS OF EQUIPMENT USE

Mattedi (2023) compares four models of IT-equipment use in computing laboratories at a public higher-education institution, using technical and financial criteria and drawing on COBIT and ITIL. In that setting, virtualization showed the lowest cost and the greatest flexibility: centralized management can create distinct environments by course without rebuilding each CPU. That result matters for maintaining entities that run several centers with the same course catalog.

Lira, Oliveira and Costa (2023) propose a hybrid architecture for virtualized classes: centralized management and distributed execution on existing resources, including legacy equipment, with open software. Preliminary results support feasibility. The operating claim is direct — the fleet need not be replaced in order to standardize the class.

The two lines complement each other. Mattedi (2023) answers the cost question. Lira, Oliveira and Costa (2023) answer the architecture question. Together they support what center managers already see on the floor: a single image, fast restore, and remote correction of the student platform.

IV. POWER, MAINTENANCE, AND REMOTE ACCESS

Workstation virtualization reduces the number of live operating systems in the laboratory and concentrates updates and antivirus on the server or hypervisor. A side effect documented in the virtual-laboratory literature is the ability to run the practical without every student depending on the same physical hardware at the same time (Silva, Ribeiro & Silva, 2023). In a network of centers that means fewer technician trips and less time with the room down.

Remote access to correct a platform — a recurring task in distance-education operations — is safe only if identity, permission, and a session record are defined. Here IT governance stops being a slogan and becomes a control: who may enter, what may be changed, and how access is audited (Mattedi, 2023).

V. LIMITS

Virtualization does not remove the need for bandwidth, uninterruptible power, and local support. Studies of virtual laboratories in other fields show gains in access and cost, but they also require training for whoever runs the environment (Silva, Ribeiro & Silva, 2023). In a small municipality the failure is more often the link and the staff than the hypervisor. Evidence through 2023 is stronger on architecture proposals and single-site cases than on multi-year cost series in private center networks.

VI. CONCLUSION

For institutions that keep a computer laboratory as a condition of a technical program or of a distance-education center, virtualization with centralized management is the model that Brazilian evidence through 2023 points to as technically and financially superior to machine-by-machine configuration. The gain is the standard image, use of legacy hardware, remote access, and fewer operating failures — not the immediate replacement of the entire fleet.

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